WHAT IS CLAIMED IS:

1. A voice activity detector that detects talkspurts in an input signal, comprising:

a frequency spectrum calculator that calculates frequency spectrum of the input signal;

a flatness evaluator that calculates a flatness factor indicating flatness of the frequency spectrum; and

a voice/noise discriminator that determines whether the input signal contains a talkspurt, by comparing the flatness factor of the frequency spectrum with a predetermined threshold.

2. The voice activity detector according to claim 1, wherein:

the input signal is provided on a frame basis; and

said frequency spectrum calculator comprises either a spectral analyzer that analyzes the given signal frame in frequency domain, or a plurality of bandpass filters that divide the given signal frame into individual frequency components so as to calculate power of each frequency component.

3. The voice activity detector according to claim 1, wherein said flatness evaluator calculates an average of spectral components of the input signal, adds

up differences between the spectral components and the average thereof, and uses the resulting sum of the differences as the flatness factor of the frequency spectrum.

4. The voice activity detector according to claim 1, wherein said flatness evaluator calculates an average of spectral components of the input signal, adds up squared differences between the spectral components and the average thereof, and uses the resulting sum of the squared differences as the flatness factor of the frequency spectrum.

5. The voice activity detector according to claim 1, wherein said flatness evaluator calculates an average of spectral components of the input signal, finds a maximum difference between the spectral components and the average thereof, and uses the maximum difference as the flatness factor of the frequency spectrum.

6. The voice activity detector according to claim 1, wherein said flatness evaluator finds a maximum value of the frequency spectrum, adds up differences between spectral components and the maximum value thereof, and uses the resulting sum of the differences as the flatness factor of the frequency spectrum.

7. The voice activity detector according to claim 1, wherein said flatness evaluator finds a maximum value of the frequency spectrum, adds up squared differences between spectral components and the maximum value, and uses the resulting sum of the squared differences as the flatness factor of the frequency spectrum.

8. The voice activity detector according to claim 1, wherein said flatness evaluator finds a maximum value of the frequency spectrum, finds a maximum difference between spectral components and the maximum value, and uses the maximum difference as the flatness factor of the frequency spectrum.

9. The voice activity detector according to claim 1, wherein said flatness evaluator adds up differences between adjacent spectral components of the input signal and uses the resulting sum of the differences as the flatness factor of the frequency spectrum.

10. The voice activity detector according to claim 1, wherein said flatness evaluator finds a maximum difference between adjacent spectral components of the input signal and uses the maximum difference as the flatness factor of the frequency spectrum.

11. The voice activity detector according to claim 1, wherein said flatness evaluator calculates an average of spectral components of the input signal and normalizes the flatness factor by dividing by the calculated average.

12. The voice activity detector according to claim 1, wherein:

the input signal is provided on a frame basis; and

said flatness evaluator calculates average power of the given signal frame and normalizes the flatness factor by dividing by the calculated average power.

13. The voice activity detector according to claim 1, wherein said flatness evaluator calculates an average of spectral components of the input signal, determines a threshold from the average, counts the number of spectral components that exceed the threshold, and uses the resulting number as the flatness factor of the frequency spectrum.

14. The voice activity detector according to claim 1, wherein said flatness evaluator finds a maximum value of the frequency spectrum, determines a threshold from the maximum value, counts the number of spectral components that exceed the threshold, and uses the

resulting number as the flatness factor of the frequency spectrum.

15. A voice-operated transmitter that turns on and off transmission signal output depending on whether a speech signal is present or not, the transmitter comprising:

(a) a talkspurt detector comprising:

a frequency spectrum calculator that calculates frequency spectrum of an input signal,

a flatness evaluator that calculates a flatness factor indicating flatness of the frequency spectrum, and

a voice/noise discriminator that determines whether the input signal contains a talkspurt, by comparing the flatness factor of the frequency spectrum with a predetermined threshold, and sets a talkspurt flag for a talkspurt period or a noise flag for a noise period;

(b) an encoder that produces a coded data stream by encoding the input signal; and

(c) a transmitter that transmits both the coded data stream and talkspurt flag when the talkspurt flag is set, and transmits only the noise flag when the noise flag is set.

16. A noise canceller that suppresses noise components in an input signal, comprising:

(a) a noise period detector, comprising:

a plurality of bandpass filters that divides the input signal into a plurality of frequency components,

a frequency spectrum calculator that calculates frequency spectrum of the input signal by processing the frequency components supplied from said bandpass filters,

a flatness evaluator that calculates a flatness factor indicating flatness of the frequency spectrum, and

a voice/noise discriminator that determines whether the input signal contains a talkspurt, by comparing the flatness factor of the frequency spectrum with a predetermined threshold, and sets a talkspurt flag for a talkspurt period or a noise flag for a noise period;

(b) a suppression ratio calculator that estimates noise power of each frequency component when the noise flag is set, and determines a suppression ratio for each frequency component, based on frame power of each frequency component and the estimated noise power; and

(c) a noise suppressor that selectively reduces noise components in the input signal by suppressing the individual frequency components according to the suppression ratios determined by said suppression ratio calculator.

17. A noise canceller that suppresses noise components in an input signal, comprising:

(a) a noise period detector, comprising:

a spectrum analyzer that calculates frequency

spectrum of the input signal through spectral analysis,

a flatness evaluator that calculates a flatness factor indicating flatness of the frequency spectrum, and

a voice/noise discriminator that determines whether the input signal contains a talkspurt, by comparing the flatness factor of the frequency spectrum with a predetermined threshold, and sets a talkspurt flag for a talkspurt period or a noise flag for a noise period;

(b) a suppression ratio calculator that estimates a noise power spectrum of noise components in the input signal when the noise flag is set, and determines a suppression ratio for each frequency component, based on the estimated noise power spectrum and the frequency spectrum of the input signal; and

(c) a noise suppressor that selectively reduces noise components in the input signal by suppressing the frequency components according to the suppression ratios determined by said suppression ratio calculator.

18. A tone detector that detects tone signal components in an input signal, comprising:

(a) a tone signal detector, comprising:

a frequency spectrum calculator that calculates frequency spectrum of the input signal,

a flatness evaluator that calculates a flatness factor indicating flatness of the frequency spectrum, and

a tone signal discriminator that determines whether the input signal contains a tone signal, by comparing the flatness factor of the frequency spectrum with a predetermined threshold, and sets a tone detection flag to indicate that a tone signal is present;

(b) a decoder that produces a decoded data stream by decoding the input signal; and

(c) a signal output controller that outputs the decoded data stream as is when the tone detection flag is set, and applies speech processing to the decoded data before outputting when the tone detection flag is not set.

19. An echo canceller that prevents echoes from occurring, comprising:

(a) an input talkspurt detector, comprising:

an input sound frequency spectrum calculator that calculates frequency spectrum of an input sound signal,

an input sound flatness evaluator that calculates a flatness factor indicating flatness of the input sound frequency spectrum, and

an input voice/noise discriminator that determines whether the input sound signal contains a talkspurt, by comparing the flatness factor of the input sound frequency spectrum with a predetermined threshold, and sets an input sound flag to indicate presence of a talkspurt in the input sound signal;

(b) an output talkspurt detector, comprising:

an output sound frequency spectrum calculator that calculates frequency spectrum of an output sound signal,

an output sound flatness evaluator that calculates a flatness factor indicating flatness of the output sound frequency spectrum, and

an output voice/noise discriminator that determines whether the output sound signal contains a talkspurt, by comparing the flatness factor of the output sound frequency spectrum with a predetermined threshold, and sets an output sound flag to indicate presence of a talkspurt in the output sound signal; and

(c) an echo canceller module that identifies states of the input and output sound signals by monitoring the input and output sound flags, and performing either a subtraction process or an echo training process depending on the identified states, wherein the subtraction process produces a pseudo echo signal by applying echo path characteristics on the output sound signal and subtracts the produced pseudo echo signal from the input sound signal, and wherein the echo canceling process updates the echo path characteristics.

20. A voice activity detection method for detecting talkspurts in an input signal, comprising the steps of:

(a) calculating frequency spectrum of the input signal;

(b) calculating a flatness factor indicating flatness of the frequency spectrum; and

(c) determining whether the input signal contains a talkspurt, by comparing the flatness factor of the frequency spectrum with a predetermined threshold.

21. The voice activity detection method according to claim 20, wherein:

the input signal is provided on a frame basis; and

said spectrum calculating step (a) comprises one of the substeps of:

analyzing the input signal frame in frequency domain, and

dividing the input signal frame into individual frequency components by using a plurality of bandpass filters, and calculating power of each frequency component.

22. The voice activity detection method according to claim 20, wherein:

said flatness calculating step (b) comprises the substep of calculating an average value of spectral components of the input signal; and

said flatness calculating step (b) further comprises one of the substeps of:

adding up differences between the spectral components and the average value,

adding up squared differences between the spectral components and the average value, and

finding a maximum difference between the spectral components and the average value.

23. The voice activity detection method according to claim 20, wherein

said flatness calculating step (b) comprises the substep of finding a maximum value of spectral components of the input signal; and

said flatness calculating step (b) further comprises one of the substeps of:

adding up differences between the spectral components and the maximum value,

adding up squared differences between the spectral components and the maximum value, and

finding a maximum difference between the spectral components and the maximum value.

24. The voice activity detection method according to claim 20, wherein said flatness calculating step (b) comprises one of the substeps of:

adding up differences between adjacent spectral components of the input signal; and

finding a maximum difference between adjacent spectral components of the input signal.

25. The voice activity detection method according to claim 20, wherein:

the input signal is provided on a frame basis; and

said flatness calculating step (b) comprises one of the substeps of:

normalizing the flatness factor by dividing by an average value of spectral components of the input signal; and

normalizing the flatness factor by dividing by average power of the input signal frame.

26. The voice activity detection method according to claim 20, wherein said flatness calculating step (b) comprises the substeps of:

calculating an average value of spectral components of the input signal;

determining a threshold from the average value;

counting the number of spectral components that exceed the threshold; and

assigning the resulting number as the flatness factor of the frequency spectrum.

27. The voice activity detection method according to claim 20, wherein said flatness calculating step (b) comprises the substeps of:

calculating a maximum value of spectral components

of the input signal;

determining a threshold from the maximum value;

counting the number of spectral components that exceed the threshold; and

assigning the resulting number as the flatness factor of the frequency spectrum.